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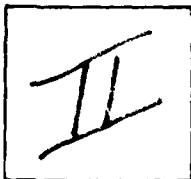
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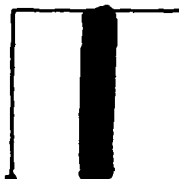
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Corps of Engineers, Waltham, MA
New England Div.



INVENTORY

Environmental Assessment of the Operation and
Maintenance of East BRIMFIELD LAKE Quinebaug River

DOCUMENT IDENTIFICATION
Brimfield, Holland and Sturbridge, Massachusetts
Oct. 73

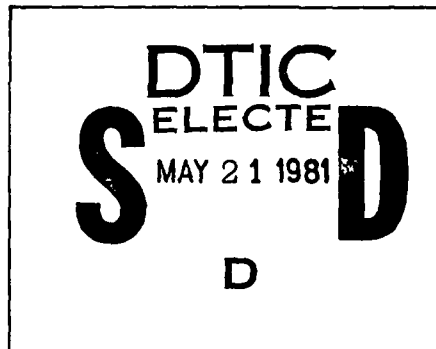
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Preface

The purpose of this Environmental Assessment is to provide the basis for evaluation of the environmental impact on the project area due to the routine operation and maintenance of this flood control reservoir. East Brimfield Lake has been operated whenever necessary since it was constructed to prevent or reduce downstream flooding. Maintenance and management of the project, including the recreation facilities, during non-flood periods is also of primary importance. Enhancement of the fish and wildlife resources as well as protection of the environment within and around the reservoir area has been given careful consideration.

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1. PROJECT DESCRIPTION

A. INTRODUCTION

1. Location and Authorization

The East Brimfield Dam and Reservoir are located on the Quinebaug River in the towns of Brimfield, Holland and Sturbridge in Hampden and Worcester Counties, Massachusetts. Authorization for the project comes from the Flood Control Act dated 18 August 1941 (Public Law 228, 77th Congress). Construction was begun in 1958 and completed in June 1960, at an estimated cost of \$7,020,000. The project is operated and maintained by the New England Division, Corps of Engineers.

2. Purposes

The dam is one of the six designated in the comprehensive plan of flood protection for the Thames River basin, effecting reductions in flood damages primarily at Sturbridge and Southbridge, Massachusetts, while helping to desynchronize flood flows at other damage centers further downstream.

Operation of the East Brimfield Dam is coordinated with the five other dams in the Thames River basin: 1) The Westville Dam, located on the Quinebaug 5.5 miles downstream from the East Brimfield Dam, controls flows from a net drainage area of 32.0 square miles below East Brimfield Dam and is operated in

conjunction with the East Brimfield project for flood protection at Sturbridge and Southbridge; 2) West Thompson Dam is located on the Quinebaug River in the Town of Thompson, Connecticut, 23.3 miles downstream from the East Brimfield Dam. This dam, which controls flow from a drainage area of 74 square miles, is regulated to reduce flood stages at damage centers from Putnam to Norwich, Connecticut; 3) The Buffumville Dam is located on the Little River in Charlton, Massachusetts, 1.3 miles above its junction with the French River, and controls flows from an area of 26.5 square miles; 4) Hodges Village Dam is located in the Town of Oxford, Massachusetts on the French River 15 miles above its confluence with the Quinebaug River. It regulates the flows from a drainage area of 31.1 square miles and is operated, along with Buffumville Dam, to reduce flood damages from Webster, Massachusetts to Putnam, Connecticut; and 5) Mansfield Hollow Dam is located in Mansfield Hollow, Connecticut, on the Natchaug River about 5.3 miles upstream from its confluence with the Shetucket. Regulation of the flows from its drainage area of 159 square miles is designed to reduce flood discharges at the communities from Willimantic to Norwich, Connecticut.

B. STRUCTURES AND RESERVOIR

1. Dam

East Brimfield Dam is rolled earth fill and rock embankment with a concrete ogee spillway section. The spillway is 75 feet long with crest elevation at 653.0 feet mean sea level (msl). Clearance for the

spillway is effected by a vertical cut into the schistose rock of the hillside at the southeast end of the embankment. The rolled earth fill embankment section is 520 feet in length with a maximum height of 55 feet. Elevation at the top of the dam is 672.2 feet msl.

The outlet works, located on the right bank, include a 10'-6" horseshoe-shaped conduit approximately 210 feet long, a service bridge, and an intake with stoplog facilities for maintenance and emergency use in lieu of emergency gates. Two 6'-3" x 11'-0" sluice gates, electrically operated, with invert at elevation 619.0 feet msl, control the flow through the dam. The discharge capacity of the outlet works at spillway crest is 2,850 cubic feet per second (cfs).

2. Reservoir

East Brimfield Reservoir at spillway elevation 653.0 contains a gross storage of 32,200 acre-feet, equivalent to 8.9 inches of runoff from a drainage area of 67.5 square miles. The reservoir at spillway crest extends about 5.5 miles upstream and has a surface area of 2,270 acres.

A conservation and recreation pool with a surface area of 360 acres at elevation 632.0 feet (13-foot stage) is maintained by a concrete box weir around the intake structure. The 90-foot long weir contains 8 stoplog sections and two 24-inch square gates for release of conservation pool storage. At elevation 632.0, the pool has a storage capacity of 2,320 acre feet, equivalent to 0.64 inch of runoff.

3. Real Estate

The East Brimfield Flood Control Project covers 2,138 acres of Government fee-owned property, including land necessary for permanent structures, borrow areas, and the lands below the 10-year frequency line (elevation 645 feet msl). The Corps of Engineers also holds 649 acres in flowage easement between elevations 645 and 656 feet msl, three feet above the spillway crest.

4. OPERATION PROCEDURES

The Reservoir Control Center coordinates Reservoir regulation activities at East Brimfield Dam with Westville Dam and West Thompson Dam for greater flood control efficiency in the Thames River basin.

1. Flood Periods

a. Minor floods

No regulation of the gates is required for minor floods where downstream safe channel capacities are not expected or exceeded. These safe capacities are approximately 1,000 cfs below East Brimfield Dam and 1,500 cfs at Southbridge (coordinated with Westville Dam).

b. Major Floods

Regulation during major floods is divided into three phases:

(1) Phase I - Appraisal of the Flood

The two flood gates at East Brimfield Dam are normally set at partially open (2'-2') positions in order to restrict flows in the event of an unexpected flood. Further restriction is based on storm rainfall (either forecasted or observed), antecedent conditions, river stages and rates of rise at Westville Lake and at Southbridge, Massachusetts.

(a) Alert

In preparation for possible flood control measures, the Corps of Engineers' Reservoir Regulation Section (RRS) in Waltham, Massachusetts is alerted whenever 1.0 inch of precipitation falls in the Quinebaug basin in a 24-hour period; whenever the stage at East Brimfield Dam rises 1 foot (to 633.0 feet msl); or when the stage at Westville rises to 12.0 feet. Further reports are based on instructions from RCC personnel.

(2) Phase II - Regulation

Regulation of flood flows becomes necessary when downstream river stages are expected to cause flooding problems.

(3) Phase III - Emptying the Reservoir

After the storm has abated and the uncontrolled downstream runoff has receded, the East Brimfield, Westville and West Thompson reservoirs are emptied as rapidly as possible while insuring that safe channel capacities are not exceeded.

2. Low Flow Periods

At the time of the dam's construction, a contract for low flow regulation was negotiated between the United States Government and the American Optical Company in Southbridge, Mass. which uses the water for electrical condenser cooling purposes. Approximately 1,100 acre-feet of storage in the East Brimfield Reservoir between stages 9 and 13 feet are made available for use by the company. Low flow releases from East Brimfield will be made only at the request of the American Optical Company and are subject to the following conditions:

- a) Water for this purpose will be released only during the period 30 June through 31 December;
- b) Reservoir level shall not be drawn below stage 12 (elevation 631.0 feet msl) before 1 August or below stage 11 before Labor Day;
- c) Reservoir level shall not be lowered more than six inches in any one week;

- d) No regulation will be permitted which, in the opinion of the Government, infringes upon downstream water rights or might contribute to downstream flooding, and
- e) Variation in the regulation procedures will be permitted only as approved by the Government.

Low flow releases will be made by use of the weir gates at East Primfield Dam. No regulation is necessary at Westville Dam. When a request for low flow release is received, the East Primfield Project Manager will contact the Reservoir Control Center for instructions.

In addition, the project manager at East Primfield Dam will release sufficient flow to sustain fish life at all times, or approximately 10 cfs.

B. MANAGEMENT PROGRAMS

1. Recreation

On July 1, 1964, a long term (25-year) license was granted to the Massachusetts Department of Natural Resources for the management of about 2,000 acres of land and water at the East Primfield Lake. The various agencies under the Department of Natural Resources are responsible for management of the many project resources. Developed public recreational areas are managed by the Division of Forests and Parks. Popular activities in the project area are swimming, boating, picnicking, hunting and fishing.

2. Fish and Wildlife

The entire project area, including Holland Pond and Lost Lake, is open to the public for fishing, subject to Massachusetts fishing laws and licensing. Typical warm water species such as sunfish, bullheads, pickerel and bass inhabit the conservation pool and ponds. The Division of Fisheries and Game is experimenting with a northern pike stocking program in the conservation pool.

The Division also stocks pheasants in the area west of the Quinebaug River and Conservation Pool, where hunting in season is permitted.

3. Forestry

There is no formal management of the forestry resource in the reservoir area. Some tree planting in the vicinity of the dam has been undertaken by the Project Manager, and clearing, thinning or planting is done as required in the developed recreational areas.

II. ENVIRONMENTAL SETTING

A. DESCRIPTION OF GENERAL AREA

1. Climate and Precipitation

The Thames River Basin, within which the Quinebaug River and East Brimfield Lake are located, has a variable climate characterized by frequent but short periods of heavy precipitation. The basin lies in the path of the "prevailing westerlies" and of cyclonic disturbances that cross the country from west to east or southwest to northeast. It is also exposed to occasional coastal storms that travel up the Atlantic coast. Some storms are of tropical origin and occasionally are of hurricane intensity, heavily laden with moisture from the ocean.

Average annual temperature of the basin is about 48°F. , varying from 50°F. near the coast to 46°F. in the northern areas. Average monthly temperatures range from highs of $68-72^{\circ}\text{F.}$ in July and August to $25-30^{\circ}\text{F.}$ in January and February. Occasional extremes in temperature reach the upper 90's with lows of minus 10°F. or lower.

The average annual precipitation over the Thames River Basin is about 44 inches, and in the vicinity of East Brimfield Dam and upland areas, about 48 inches. The precipitation is quite uniformly distributed throughout the year.

Annual snowfall in the Thames Basin varies from about 30 inches in the southern portion to more than 50 inches at the higher elevations in Massachusetts. For 19 years of record at Southbridge, the mean annual snowfall has been 55.5 inches.

For the basin as a whole, the average annual runoff is about 22.5 inches (1.64 cfs per square mile) or just over 50% of the precipitation.

2. Topography

The general terrain around the project is hilly with ranges tending to run in a north-south direction. In contrast, much of the reservoir area is low-lying swamp land which would be flooded at full pool elevation. There are numerous lakes, ponds and marshes in the Towns of Sturbridge, Brimfield and Holland, situated in valleys formed by rounded hills rising to elevation 1,000 feet msl and higher.

3. Vegetative Cover Types

A major portion of the land in the Towns of Brimfield, Holland and Sturbridge is forested. The rolling terrain in the vicinity of the dam has limited the locations of agricultural development to the valley bottoms and gentler sloping hillsides.

4. Fish and Wildlife Species Present

East Brimfield Reservoir contains a number of species of warm water fish sought by anglers, including chain pickerel, large-mouth bass, bluegills, pumpkinseeds, yellow perch and brown bullheads as well as brindled shiners, common shiners and other forage species.

The principal game species present on the reservoir lands are cottontail rabbits, ruffed grouse, woodcock, gray squirrels, black ducks, wood ducks, whitetail deer, and a few varying hares and some woodchucks. Muskrats, minks and otters are also found in varying numbers at the project. Other species include red foxes, raccoons, and a host of song birds, squirrels and chipmunks.

5. Geological Features

The soils of the swampy portions of the reservoir are classified as peat and muck, originating from accumulated decaying organic matter in what apparently was an ancient lake bed. The high water table in these pre-existing swamps has deterred use of the rich lands for agriculture. However, the land underlying the Conservation Pool was originally a high-yield agricultural area, rich in nutrients. Soils on the slopes are of the Gloucester series, coarse in texture having developed mainly from weathering of crystalline schists and gneisses and accumulated by glacial action. The upland soils are mostly gravel and hardpan covered with a layer of humus, and thus would be resistant to any erosion caused by increased recreational activity in this area.

6. Socio-Economic Conditions

a. Population

The Towns of Sturbridge, Brimfield and Holland experienced significant population growth between 1960 and 1970.

User surveys conducted by the New England Division, Corps of Engineers have shown that 60 percent of the average 250,000 visitors to the East Brimfield project live within 25 miles of the reservoir. Many residents of the surrounding towns have thus made use of the recreational facilities. The project has also helped to alleviate the shortage of water-based recreational opportunities within driving distance of the Springfield metropolitan area.

The Town of Holland has no important manufacturing or other industrial base and is primarily a residential area in an attractive rural setting. Major industries in the Town of Brimfield are a dairy products firm and a commercial printing firm. Agriculture is limited to a number of smaller farms in the area, with dairying and poultry raising the most important activities.

There are a number of factories, commercial buildings and residences situated on the flood plain of the Quinebaug River in Southbridge, Massachusetts and in other downstream communities. With Westville Dam only a short distance upstream from Southbridge and East Brimfield Dam a few miles further

away, the city is well protected from floods of intermediate magnitude. However, this assurance should not be used as a substitute for appropriate zoning or other regulation of development on the ecologically valuable flood plain (see Section V. C.)

The East Brimfield Lake area is readily accessible to a large population by a number of excellent roads which serve the region. The Massachusetts Turnpike (Interstate 90) and U. S. Route 20 pass just north of the project.

b. Water Uses

Above East Brimfield Dam, the most important water use is for recreation, especially boating, water skiing and fishing in the conservation pool. Fishing is also an important use of the Quinebaug River and adjacent ponds, and swimming is a frequent activity at Holland Pond and the conservation pool.

Downstream of the dam, industrial water supply constitutes the major use of the Quinebaug River. Harrington Cutlery Company, American Optical Company and West Dudley Paper Company are all located above the confluence of the Quinebaug and French Rivers and utilize the river flow for various manufacturing processes.

III. ENVIRONMENTAL IMPACT OF THE OPERATION, MAINTENANCE AND
MANAGEMENT PROGRAM

A. OPERATION FOR AUTHORIZED PURPOSES

1. Downstream Effects - Regulation of Flows and Releases

a. Flooding Prevented

Since its completion in 1960, the East Brimfield project has been in operation about six times for significant flood regulation and has prevented downstream damages of more than \$2.2 million, primarily in Sturbridge and Southbridge, Massachusetts.

Owing to the concentration of population and industry along the Quinebaug River and tributaries, agriculture has been generally limited to the upland areas. Furthermore, much of the land originally cleared for farming has been allowed to revert to forest growth. Therefore flood mitigation benefits for agricultural land are relatively unimportant when compared with the protection offered to urban land uses by the project.

As is the case in many other areas, there has been no meaningful attempt at flood plain zoning by towns and cities along the Quinebaug River. In fact, the operation of both East Brimfield and Westville Dams for flood control has induced some further growth in flood-prone areas. For example, a shopping center was built several years ago in the flood plain of the Quinebaug in the Southbridge area. No consultation was held with officials responsible for the flood control projects to assess the probability and frequency of flooding at the construction site. Because the dams afford substantial protection downstream, and preserve valuable industries and business from damaging inundation, they have unfortunately provided security to buildings on the flood plain, when, for both ecological and safety reasons, this zone ought to be protected from further development.

b. Fish and Wildlife

The flow regulation and release procedures at East Brimfield Dam do not significantly alter the downstream capability for supporting fish life. Runoff from the upper Quinebaug River basin is relatively slow due to the gently rolling topography and the absence of very steep stream gradients. The retarding of spring freshet flows or summer storm runoff by the reservoir is followed by regulated discharges

which are normally in the range of 500 to 1,000 cubic feet per second, depending on the volume of water stored. Although such regulated flood flows are consistently less than would occur naturally, the policy of evacuating the reservoir and recovering the flood storage capacity as rapidly as possible ensures that the flushing action of higher flows is not lost completely. At the same time, excessive accumulation and transport of eroded soil, silt, vegetative litter and other debris harmful to the downstream fish populations are somewhat avoided when suspended matter settles out in the reservoir. In late summer and autumn, low flow regulation for American Optical Company at Southbridge serves the second function of providing slightly higher flows in the Quinebaug River below East Brimfield Dam. The aquatic life existing in this reach also benefits from the augmented flows from East Brimfield Reservoir in the critical late summer and early fall months. This too may somewhat benefit the Division of Fisheries and Game's trout stocking program in the Quinebaug River below the dam, as low flow regulation effectively lengthens the good trout fishing period well into the summer and fall months. Fishing pressure there, however, is only light to moderate.

c. Vegetative Cover and Timber

Flood control operations at East Brimfield Dam have caused fewer instances and lesser degrees of flood plain inundation downstream of the dam, since care is taken to limit reservoir discharges to the safe channel capacities or less. However, the streamside vegetation, especially larger trees, have been influenced very little by the mitigation of flood flows. On the other hand, because the river now overflows its banks only rarely, smaller herbaceous plants normally associated with the stagnant pools left by floods have been adversely affected. The major values of the timber resource are for aesthetics and erosion control. With the reduced scouring force of controlled flood flows, bank erosion and undermining of streamside tree root systems are also decreased.

d. Water Quality

The Quinebaug River is classified as a "B" stream from its sources to the western boundary of the town of Southbridge. The Massachusetts Division of Water Pollution Control (DWPC) describes Class B waters as: "Suitable for bathing and recreational purposes including water contact sports. Acceptable for public water supply with appropriate treatment. Suitable for agricultural, and certain industrial cooling and process uses; excellent fish and wildlife habitat; excellent aesthetic value."

In July and August of 1965 and August of 1972, the DWPC conducted detailed water quality surveys of the Quinebaug River. Data from the sampling station near Old Sturbridge Village indicated for both summers that the stream met Class B standards.

During the spring, summer and fall, personnel of the Water Quality Laboratory of the New England Division, Corps of Engineers also carry out routine water quality monitoring of East Brimfield Reservoir discharges and inflow, as well as of the impoundment itself. Trace metals, notably iron, magnesium, manganese, zinc and mercury were detected in the reservoir discharges in minute quantities during May through August 1971 and July - August 1972. Dissolved oxygen, (D.O.) turbidity and conductivity measurements were consistently as good as or improved over the corresponding inflow concentrations, while water temperature at discharge remained about equal to that of incoming water.

The overflow weir, controlling the conservation pool elevation, discharges water from the surface of the reservoir. The available data provided by the Corps' Water Quality Laboratory suggest that little, if any, quality degradation occurs with respect to the discharge water, and that in many instances, conditions moderately improve.

c. Recreational Use and Aesthetics

No major recreational facilities downstream are affected by East Brimfield Reservoir operation. A 23-acre recreational pool is maintained at Westville Dam, but its use is limited to non-flood periods, when elevations are normal.

During periods of high runoff and flood storage, the log boom and trash racks catch floating and submerged branches, brush, and other refuse to protect the flood control gates and outlet works. Such material is thereby prevented from affecting flood control operations and to possibly clog the stream channel. After recession of flood waters in the spring, one or two weeks are often spent manually removing the accumulated trash.

However, such dead trees, branches, leaves and other organic detritus are a natural part of the forest, and have both aesthetic and ecological values in the total reservoir environment. The material decomposes and adds to the humus layer of the forest floor to provide a substrate for worms, grubs, fungus, insect larvae and other small plants and animals. Therefore, its removal from the reservoir may adversely affect the intricate balances among many forest biota, both upstream and downstream, by preventing its deposition in the downstream flood plain and flood prone forested areas.

2. Upstream Effects in Reservoir

During March of 1968, the reservoir was filled to 35 percent of its flood control storage capacity, the largest utilization which has occurred to date. Since its completion in 1960 there has been no occasion to utilize significant amounts of storage for flood control during the summer and autumn months; the reservoir has been maintained at relatively constant levels during these periods. The reservoir was drawn down to elevation 628 feet msl, the minimum conservation pool level, only once for low flow regulation. This occurred after Labor Day of 1965 during a significant drought period.

a. Fish and Wildlife

Prior to the construction of East Brimfield Dam, the reach of the Quinebaug River within the reservoir area was known locally for its good brown bull head fishing. These warm water species are still abundant in the inundated portion of the river (about 2.2 miles) as well as in the conservation pool.

The pool is frozen over for varying lengths of time each winter with no changes in pool elevations occurring. Opportunities for ice fishing have therefore increased because of the larger surface area and stable water levels of the reservoir.

Other effects are felt because of the retention of spring flood flows. Depending on the timing and duration of flooding, there may be varying effects on the spawning cycles and habits of the warm water fish present. Northern pike and yellow perch are early spawners, beginning shortly after the ice melts in the spring. Most of the warm-water species move into shallower areas to spawn; therefore, there is a strong possibility almost every year that either the eggs or the hatched fry will be stranded when flood waters recede. Bluegills and largemouth bass probably avoid this difficulty for the most part, because they spawn near the end of May or later, after the reservoir has usually returned to the conservation pool level.

Some of the marsh areas and certain lengths of the Quinebaug River and Mill Brook provide good habitat for black ducks and lesser numbers of wood ducks, especially where aquatic weeds are abundant. Water level fluctuations in the spring reduce the suitable nesting areas for ducks. Also, rapid evacuation of the reservoir limits the potential of the swamp areas for waterfowl propagation. These areas then may be suitable only as temporary resting areas during migration.

b. Vegetative Cover and Timber

The East Brimfield project contains about 650 acres of wooded upland areas, only a small portion of which has been inundated since flood control operations began in 1960. Most of the second-growth forest cover is situated in a narrow band on the steeper slopes along the reservoir perimeter. The species composition is typical of southern New England forests and woodlots, with multi-aged deciduous trees predominating and eastern hemlock and white pine mixed throughout. There is very little evidence of tree damage due to flooding at the East Brimfield project. Although several hundred acres of land have been inundated a few times for periods up to 2 weeks or more, a substantial portion of the area submerged has been open marsh, bottom-land brush and wooded swamp. Red maple, a tree species which is quite tolerant to a wide range of moisture conditions, is common in the lower-lying areas of the reservoir. The species range from brush-size in the wettest areas along the streams to fair-sized trees on the edges of the wetlands. Alder, black willow, flowering dogwood, viburnum and other species make up the understory and brushy cover in the broad, flat bottomlands.

Generally the environmental effects of early spring flooding are less detrimental than would be expected during late summer when large volumes of runoff have been impounded for extended periods. When spring flood flows are at their highest, most of the affected plants have not or are just beginning to leaf out, thus being more resistant than when they are in full leaf and inundated for a long period.

The major detrimental effect of all flood control reservoirs is that they will tend to delay or perhaps stop indefinitely the successional changes in vegetation which would occur naturally. The amount and frequency of flooding governs to a degree not only the kinds of species present, but also the size they attain. From the viewpoint of waterfowl and upland game interests, the resultant maintenance of open grassy meadows and swamps mixed with brush cover is desirable. Such habitat is ideal for ruffed grouse, woodcock and cottontail rabbit. Thus, while the forestry resources cannot maintain their pure state and may be prevented from attaining full growth, nature has yet adjusted and compensated by developing good wildlife habitats.

Aquatic weeds have created problems in the conservation pool, especially along the shoreline and swimming beach areas. Water milfoil (*Myriophyllum heterophyllum*) has invaded the pool because of the rich supply of nutrients available and the slow-moving water. Underlying the conservation pool are former agricultural lands and soils with abundant organic matter. The character of the flooded land along with the high nutrient load of reservoir inflows make excessive algae and weed growths inevitable in such a shallow impoundment. (See Section III.B.3.)

c. Recreational Use

Flood control operations at East Brimfield Dam have not precluded any recreational use of the lands or facilities as yet. Major impoundments have all occurred in the spring, usually before water-based recreation has begun on a large scale. However, accessibility to the Quinebaug River and Mill Brook has been hampered during the opening weeks of trout fishing season and stocking has likewise been delayed due to flooding, primarily of the roads. At the Holland Pond swimming area, the change houses have been partially inundated at least once, requiring minor maintenance repairs before the summer season. Most of the facilities associated with the day-use areas at Holland Pond and Streeter Point and those proposed at Lost Lake are subject to inundation. The buildings have been designed, however, to withstand some flooding without incurring major structural damage.

d. Aesthetics

Some cleanup work around the recreational areas is required after flood control operations. This consists basically of removing any debris left by the receding water. The conservation pool at elevation 632 feet msl has a tree-covered shoreline for most of its length since clearing at the time of construction was only up to the maximum conservation pool level.

The maintenance drawdown of the conservation pool and Holland Pond in the winter of 1970-1971 met with local disfavor because of the unsightly exposed mud flats. The operation was justifiable as an attempt to control aquatic weeds by freezing them rather than by using chemical methods. Such weeds were, in fact, an adverse effect on the aesthetics of the pool resulting in part from creation of the reservoir on rich agricultural land. Termed a partial success by the East Brimfield Project Manager, the drawdown probably limited weed growth somewhat during the following summer, although they subsequently reappeared. The adverse public reaction could probably have been avoided with a reasonable public relation and education program, explaining the purpose of the operation.

e. Agricultural and Grazing Activities

The Project Manager at East Brimfield Dam has received very few requests for the releasing of Government-owned lands for agriculture. No grazing animals are pastured on the relatively small areas of reservoir land which would be suitable for the purpose. Permission has been granted to a few parties to ride and keep ponies on small parcels near surrounding homes. In keeping with a multiple use management policy, pony riding and other selective uses could not only be permitted, but actually encouraged.

f. Beneficial Uses of Water

The American Optical Company, a manufacturing plant in Southbridge, Massachusetts, has a lease to utilize water released from East Brimfield Dam during low flow periods. The firm is assured of a reliable supply within the terms of the lease agreement and at the same time is afforded a high degree of flood protection by both East Brimfield and Westville Dams. No domestic, industrial or agricultural concerns make significant use of the water behind the dam, other than normal use of this outflow.

B. CONSTRUCTION AND MAINTENANCE OF PROJECT FACILITIES

1. Recreational Facilities

The East Brimfield Reservoir area contains four major public use developments: Holland Pond, the Conservation Pool, Long Pond, and Lost Lake. Key characteristics of sites within each of the areas are listed in the following table. Overall management of the recreational facilities is the responsibility of the Massachusetts Department of Natural Resources under a 25-year renewable lease. The existing and proposed structures and physical improvements offer a wide range of recreational opportunities and services at the various sites throughout the reservoir. Likewise the environmental considerations differ from area to area and warrant discussion.

a. Area I - Holland Pond

Site No. 1

This site has been managed and operated as a State Park since 1963 by the Massachusetts Department of Natural Resources. Public utilization of the swimming, boating and picnicking facilities has been substantial; estimated visitation in 1971 was almost 63,000 based on Corps of Engineers car counts. Commonly on summer weekends and holidays the park has been closed to some visitors because of capacity crowds and shortage of tables and fireplaces.

RECREATIONAL FACILITIES AT EAST BRIMFIELD DAM AND RESERVOIR

<u>AREA 1 - HOLLAND POND</u>	<u>FACILITY</u>	<u>UNIT</u>
Site 1 - Day-Use	Roads	1,100 l.f.
95 acres	Parking	200 cars
1,200 ft. shore frontage	Beach	40,000 sq. ft.
	Picnic Tables	100 units
	Fireplaces	100 units
	Comfort Station (flush)	2 units
	Change Shelter	1 unit
	Drinking Water	1 system
	Boat Ramp	1 unit
Site 2 - Day-Use	Access Roads	2,000 l.f.
50 acres	Parking	40 cars
2,700 ft. shore frontage	Picnic Tables	6 units
	Fireplaces	6 units
	Boat Ramps	2 lanes
	Boat Landings	1 area
Site 3 - Camping	Access Roads	1,400 l.f.
75 acres	Parking	30 cars
1,000 ft. shore frontage		
<u>AREA II - CONSERVATION POOL</u>		
Site 4 - Streeter Rd. Day-Use	Access Road	800 l.f.
15 acres	Parking	80 cars
2,000 ft. shore frontage	Beach	45,000 sq. ft.
	Comfort Station	1 unit
	Parking (cars & trailers)	20 spaces
Site 5 - Project Vista	Parking (cars)	10 spaces
10 acres	Boat Ramp	2 units
2,000 ft. shore frontage	Picnic Tables	12 units
	Fireplaces	6 units
	Comfort Station (pit)	1 unit
Site 6 - Streeter Rd. South	Access Roads	1,200 l.f.
20 acres	Parking	30 cars
2,500 ft. shore frontage		
<u>AREA III - LONG POND</u>		
Site 7 - Boat Access East	Parking (cars & trailers)	20 spaces
5 acres	Boat Ramp	1 lane
1,200 ft. shore frontage	Picnic Tables	4 units
	Fireplaces	2 units
	Comfort Station (pit)	1 unit
Site 8 - Champaux Road	Access Road	400 l.f.
10 acres	Parking	10 cars
4,000 ft. shore frontage		
<u>AREA IV - LOST LAKE</u>		
Site 9 - Group Outing & Camping	Access Road	1,400 l.f.
50 acres	Parking	25 cars
1,500 ft. shore frontage	Boat Mooring	1 pier

At the time of construction of the present recreational facilities, much of the forest understory was removed and trees selectively thinned to accommodate picnic tables and fireplaces. The more open land has been seeded with perennial grasses for soil stabilization and protection. These procedures have helped to favorably accommodate heavy seasonal day-use recreation in an attractive environmental setting. Among the picnic areas, ample shade and pedestrian traffic have combined to limit the understory hardwood growth with a minimum of added maintenance.

The minimum amount of shrubby vegetation and the trimming of lower branches from the larger trees has given the picnic area a rather stark and uninteresting appearance and has limited utilization of the area by nesting songbirds and other non-game wildlife species which thrive in the forest understory vegetation.

Picnic tables, fireplaces, descriptive signs, the comfort station, change shelter and roads are all repaired as the need arises. On several occasions, the Corps of Engineers has brought in sand to improve the beach area both above and below water level, where frequent flooding has occurred.

At present, there is only one entrance road to the park. The positioning of the parking lot at the end of the road, a few hundred feet above the beach is such that it is reasonably near the picnic areas, and at the same time, well screened by trees. Furthermore, the area has not been cut up by an intersecting pattern of roads. All automobiles are grouped in a single lot rather than scattered throughout and are not allowed beyond the parking area. The design of a single access route has thus enhanced the recreational aspects of the site by freeing visitors from the constant migration of cars past the picnic areas.

Site No. 2

The second site contains only an existing access road and 6 picnic tables with fireplaces. The Corps of Engineers' Master Plan for Reservoir Development has designated this site for future expansion of recreational facilities to ease the pressure on Site No. 1. No construction or maintenance other than general surveillance is now required in the area.

Site No. 3

This area has been designated as a camping area in the later phases of reservoir development and no constructed facilities requiring maintenance exist now.

b. Area II - Conservation Pool

Site No. 4

Streeter Road Day Use Area offers a public swimming beach and comfort station. The Department of Natural Resources operates and maintains the area and charges an entrance fee. The usual maintenance associated with the recreational facilities produces no significant environmental impacts.

Site No. 5

Project Vista is a convenient rest stop for travelers on Route 20 with a good view of East Brimfield Dam and the conservation pool. Use of the small area and limited facilities constitutes no environmental problems for maintenance other than normal wear and weathering of exposed picnic tables and fireplaces.

Site No. 6

Streeter Road South is located on the south shore of the pool, opposite the Streeter Road Day Use site. No formal recreation facilities have been installed, although future development is planned.

c. Area III - Long Pond; and Area IV - Lost Lake

Besides a small parking lot, 4 picnic tables, 2 fireplaces and 1 comfort station constructed at Site No. 7 on Long Pond, Sites No. 7, 8 and 9 contain no other man-made facilities necessitating special maintenance which might produce environmental effects. Site No. 7 contains a natural boat ramp that is frequently utilized because of ready access roads and natural parking areas, but use of Champaux Road is restricted by reservoir operations. Site No. 9 on Lost Lake is now being developed as a group camping area to take advantage of the natural environment and ready access to the lake. The plans indicate no significant alteration of the area except construction of a comfort station, entrance road and small parking facilities.

2. Sewage and Solid Waste Disposal

All the comfort stations at East Brimfield Lake have been wisely constructed near or above spillway crest elevation of 653.0 feet msl. They are never subject to flooding by the reservoir and therefore do not represent a hazard to reservoir water quality.

Numerous trash barrels at the major picnic and other public use areas encourage visitors not to litter in the reservoir area. However, the presence of receptacles and their conscientious utilization do not necessarily go hand in hand and periodic cleanup is required by Corps of Engineer and DNR personnel. Nevertheless, the recreation areas are usually clean and no adverse effects from use can be discerned.

3. Aquatic Plant Control

Excessive aquatic weed growth has become a severe problem in the East Brimfield conservation pool, adversely affecting swimming at the Streeter Point beach and also boating in the entire lake. A combination of factors has produced and aggravated the situation: 1) because the pool is quite shallow, sunlight can penetrate to the bottom of most of the impoundment; 2) much of the reservoir is underlain by fertile land which was productive in agriculture prior to flooding, and thus the bottom soils are rich in nutrients; 3) quiescent conditions in the pool contribute to a suitable aquatic environment for weed growth; 4) the flow of the Quinebaug River adds to the nutrients already in the lake; and 5) because the pool area is so large it becomes an effective nutrient trap.

Several methods of weed control have been tried at the East Brimfield project. During the summers of 1966 and 1967, the pool elevation was raised two feet (to elevation 634.0 feet msl) for the purpose of providing more suitable depth for swimming at the Streeter Point beach and also to submerge aquatic weeds for improved boating. It was hoped that a reduction of sunlight intensity caused by the increased depth would have an inhibitory effect on weed growth. From December 1970, through February 1971, the pool was lowered to stage 6.5 feet (625.5 feet m.s.l.) exposing about 140 acres of shoreline with the hope of freezing the weeds. The East Brimfield Project Manager termed the operation a partial success. The method is at best a temporary solution which cannot be relied upon for long-term relief from the problem of excessive aquatic weeds.

The primary nuisance weed has been the water milfoil (Myriophyllum heterophyllum). This bottom-attached weed is very difficult to control mechanically because the stems are weak and break easily, leaving the root system intact in the bottom sediments. Members of the genus Myriophyllum are often sold in aquarium supply shops because of their general beauty. The most recent attempt to prevent growth of water milfoil was in October 1972. The conservation pool was treated with a commercial preparation called "Kuron" manufactured by Dow Chemical Company. The main ingredient in "Kuron" is Silvex, a herbicide which has been used for woody tree control as well as for destroying submerged and emergent aquatic weeds. The pool was treated to an average depth of 6.4 feet in two stages a week apart. The quantity of Kuron used was 782 gallons, resulting in a final concentration of about 0.05 mg./lb. of Silvex in the reservoir. Careful chemical analysis and monitoring before, during and after treatment were conducted to avoid unnecessary environmental impacts. Both the Corps of Engineers and the State Division of Fisheries and Game took water samples. The results appear to be acceptable; but positive evaluation will only occur in the summer of 1973, when conditions are again optimal for weed growth.

There were no reported fish kills associated with the chemical treatment but more subtle environmental drawbacks may exist. First of all, "Kuron" is not recommended for use when the water temperature is below 50°F. While it is not certain whether this condition was met, since October 1972 temperatures only went below 50°F. in the latter part of the month, the result would be to limit the effectiveness of the treatment, but also might limit the adverse effects on fish. Secondly, however, Silvex is non-selective and slow-acting. Therefore, aquatic plants other than the object milfoil were probably affected adversely. Thirdly, it is doubtful that the weed problem will be much less in a year or two than it was prior to treatment. "Chemical treatments offer, at most, temporary relief from the problem of overabundance of aquatic vegetation. Even when the best possible results are obtained, the treatment must be repeated on an annual basis". Finally, little is known about the breakdown and long-term effects of sublethal concentrations of Silvex or other aquatic herbicides on fish and plants. If annual treatment were instituted, then the adverse effects would be magnified, but it is unlikely that a single treatment would inflict lasting damage.

4. Weed and Brush Control

Most of the secondary roads acquired on fee lands at the time of project construction have been released to the respective towns for maintenance. The towns have responsibility for control of roadside vegetation along these roads. In addition, the Project Manager does not allow use of salt on the roads which might adversely affect the vegetation during runoff, as well as the water

quality of the reservoir. As pointed out in Section III. B. 1. a. above, public use has been sufficient to prevent the regeneration of brush and understory vegetation in those recreation areas where such growth would be troublesome. The forest canopy and undergrowth bordering access roads to recreational sites have been preserved.

The reservoir roads form relatively narrow, pleasantly natural corridors rather than wide swaths through the woods. Whatever brush trimming is required is done manually or mechanically and no chemicals are employed.

In the planting and landscaping activities at the project no chemical fertilizer is used which might cause adverse environmental effects. It is probable, however, that the borrow area below East Brimfield Dam could benefit aesthetically with judicious use of fertilizer, because the red pines planted for reforestation are faring poorly.

C. MANAGEMENT OF PROJECT LANDS

1. Rules and Regulations

Because the recreation programs at East Brimfield are administered by the Massachusetts Department of Natural Resources, current rules and regulations of the Division of Forests and Parks governing use of State Parks and facilities also apply to the reservoir lands and waters. Hunting and fishing are allowed in accordance with Massachusetts State laws enforced by the Division of Fisheries and Game through local conservation officers.

The rules basically prohibit any activities which endanger the safety of recreational users or result in damage to buildings, picnic facilities, signs or other reservoir property. Fires are permitted on Government land only in those areas where fireplaces are provided for picnickers. The State Park standards are not overly restrictive but they do set forth common-sense guidelines the observance of which helps to protect the environment for the benefit of everyone.

2. Fish and Wildlife Management

Although the East Brimfield project is not under intensive management by the Massachusetts Division of Fisheries and Game, the agency is concentrating some management effort on the conservation pool. In March, 1967, twenty-eight adult northern pike were released into the impoundment. The fish were live-trapped at the northern end of Lake Champlain by the Vermont Fish and Game Department. The Massachusetts Division was not able to determine whether any natural reproduction of the species occurred with such a small scale introduction. Although no positive results were experienced, recent State surveys have reinforced the belief that the lake presents good northern pike habitat and the experiment has been continued.

The latest attempt at northern pike stocking in East Brimfield Lake was scheduled to occur prior to April 15, 1973, after the Division of Fisheries and Game arranged to purchase 3,000 pounds of the fish from a commercial dealer in Minnesota.

If the northern pike are successful in the reservoir, a number of changes could take place. The pike is a voracious species and preys almost exclusively on smaller fish, therefore overabundant species may be controlled to some extent. The pike an an excellent game fish which has not typically fared well after artificial introduction in Massachusetts waters. (The experiment has been tried in Rhode Island where results were somewhat better.) It is certain that fishermen will seek the species and angling pressure on the reservoir ought to increase substantially. If the pike do reproduce naturally in the reservoir, moderately heavy fishing will probably be a necessity to stabilize the populations. Thus, increased and improved fishing would benefit the aquatic environment as well by maintaining a desirable equilibrium of fish populations in the reservoir.

The State stocks some pheasants in the extensive swamp and brush land along Mill Brook. However, survival of birds not taken during the hunting season is poor since agricultural land is limited. Although the stocking program does provide some hunting, it is likely that unmanaged game species, such as cottontail rabbits and ruffed grouse, make up most of the hunters' take from the reservoir. Nevertheless, the public availability of the project lands for hunting, whether or not managed intensively for game, represents a most important environmental resource for sportsmen in the surrounding areas.

3. Recreational Use and Management

Management of recreation facilities is primarily the responsibility of the Massachusetts Department of Natural Resources, under a 25 year renewable lease. State personnel are on duty full time during the summer season, from May 1st to September 15th, at the Holland Pond and Streeter Point Day-Use areas. Heaviest recreational use of the East Brimfield project is concentrated in these two sites. Year-round surveillance is provided by the Wells State Park Staff, who police the area periodically.

At Holland Pond, the Quinebaug River forms an effective natural boundary for recreational activities. The river boundary and the single entrance gate for visitor control alleviate management and supervision problems at the picnic area. The Streeter Point site is accessible only from U. S. Route 20, and recreational management is therefore simplified.

The remainder of the reservoir is divided by numerous streams, water bodies, and wetlands, upon which fishing and some waterfowl hunting is conducted. Environmentally, these natural divisions are highly beneficial, because visitors are constrained from roaming too freely throughout those project areas which are presently in a natural state and not formally managed.

4. Forestry Management

The Corps of Engineers has planted several thousand red and white pine seedlings in the former borrow area downstream from the dam. In addition, the project personnel cultivated and grassed in the slopes adjacent to the dam, for aesthetic purposes, and also planted ornamental trees and shrubs. Characteristic of the Corps forestry practices was the attempt to thin out and trim a thick grove of poplar trees on the shore of the conservation pool near the dam. The objective here was to facilitate pedestrian access to the reservoir's shore for nature walks and hiking. Unfortunately, poplars are a stubbornly resilient pioneer species and grew back quickly. It was decided to let the area return to its natural condition.

In the reservoir proper, neither cutting nor planting has been undertaken except to clear or improve areas for recreational use. The scenic value of existing timber resources justifies leaving most of the trees undisturbed.

5. Pollution Control

The Massachusetts Department of Public Health's State Sanitary Code (Article VII, "Minimum Standards for Bathing Beaches") requires that water samples be taken and analyzed at least twice monthly during the bathing season at all accredited bathing beaches. It also recommends that samples be taken prior to opening of the bathing season and weekly thereafter. A coliform count of more than 1,000 per 100 ml is a guide for additional investigation. The Holland Pond and Streeter Point

swimming areas are carefully monitored according to state regulations in order to assure the health and safety of bathers. They have been found to conform to all standards.

Sanitary facilities at East Brimfield Lake are above reservoir flood stages to protect the water quality. Facilities are adequate to treat and dispose of domestic wastes and conform to Article XI of the State Sanitary Code, "Minimum Requirements for the Disposal of Sanitary Sewage in Unsewered Areas." The Division of Water Pollution Control has also identified no significant point sources of domestic or industrial wastes on the Quinebaug River upstream of East Brimfield Dam which might necessitate pollution control measures at the project.

IV. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED AS A RESULT OF THE OPERATION AND MAINTENANCE PROGRAM

A. FISH AND WILDLIFE - DOWNSTREAM CHANGES

East Brimfield Dam inescapably modified the patterns of spring freshet flows in the Quinebaug River. These changes in turn affect the productivity of the downstream fishery by reducing the extent of shallow spawning areas for warm water fish, and by limiting food production in the stream's flood plain. Restraining the river from overflowing its banks results in a decline in the number of pools which normally fill by flooding and drain slowly afterwards. These pools are an important breeding ground for insects which make up a portion of the diet for trout, other fish and for birds. Modification of these areas adversely affects the entire food chain of wildlife species. Whether this is unavoidable depends on the extent of natural flooding.

B. WATER QUALITY-DOWNSTREAM RELEASES

Operation of East Brimfield Dam has insignificant effects on downstream water quality. The available data, of both the Massachusetts Division of Water Pollution Control (DWPC) and the Corps of Engineers Water Quality Laboratory, suggest that the Quinebaug River below the Dam is of a "B" standard in quality. Because the DWPC quality surveys were conducted in the critical low-flow months of the summer, discharge during other times of the year frequently is of a higher quality. (See Section III A. 1. d. above for further discussion.) The surveys identify no water quality parameters for which operation of East Brimfield Dam is the cause of serious degradation. The Quinebaug River also connects a series of larger water bodies, including Mashapaug Pond, Hamilton Reservoir, Holland Pond and Lost Lake, before the river reaches the conservation pool at East Brimfield Dam. Therefore, summer water temperatures range in the 70's and even sometimes the 80's (⁰F) and no further increases are usually experienced at the outflow of East Brimfield Reservoir.

C. FISH SPAWNING - WATER LEVEL FLUCTUATIONS AND DRAWDOWN

Some unavoidable impacts occur in relation to conditions for fish spawning as a result of East Brimfield flood control operations. Chain pickerel, yellow perch and northern pike spawn in early spring and their eggs take 2 or 3 weeks to hatch. The generally unstable water levels caused by dam and reservoir operations at this time of year are detrimental

to natural reproduction of largemouth bass and brown bullhead and cannot be avoided when flooding occurs in late May or early June and these species are spawning.

D. WILDLIFE HABITAT - PERIODIC INUNDATION

Authorized flood control operation of East Brimfield Dam necessitates periodic inundation of several hundred acres of land normally occupied by numerous species of mammals and birds. Moreover, flooding limits the range and mobility of resident wildlife in all parts of the reservoir.

While operation of the smaller Westville Reservoir is closely coordinated with East Brimfield, its pool stage rises more rapidly, and its net storage capacity is less. Thus, although the East Brimfield Reservoir rises slowly in relation to its surface area, its storage capacity must be utilized when flood stages so necessitate. There is little possibility of less conservative operation to decrease flooding of the reservoir land without adversely affecting the degree of downstream protection offered by the entire system.

E. VEGETATIVE COVER AND TIMBER - PERIODIC INUNDATION

The adverse impacts of extended flooding and the cumulative effects of short-term inundation on herbaceous and woody plants are foreseen consequences of operating any reservoir for flood control. Because the maximum clearing elevation was set at 632.0 feet msl, the normal conservation pool level, trees bordering the pool above this level are regularly flooded, as is a considerable acreage of brushy swamps and streamside vegetation. It is thus inevitable that some trees and plants within the contours where flooding is frequent will become gradually weakened or may die. However, tree mortality has not yet been widespread enough to impair the aesthetic character of the shore.

V. ALTERNATIVES TO THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM

A. DISCONTINUANCE OF AUTHORIZED FLOOD CONTROL OPERATION

If East Brimfield Dam ceased operation, the Westville Reservoir's present storage of 11,000 acre-feet, or 6.3 inches of runoff from the net drainage area, would be reduced to the equivalent of just over 2 inches of runoff from the total upstream drainage. Clearly the elimination of East Brimfield Reservoir would overtax Westville Reservoir and severely jeopardize the safety of developed areas in Southbridge and other downstream communities, subject to flood

hazards. This alternative is not feasible either economically nor environmentally and would not be unless all existing and future developments in flood-prone areas were removed or prevented.

R. LAND MANAGEMENT ALTERNATIVES

1. Discontinuance of Land Management Activities

In light of ever-increasing recreation demands and a limited supply of public land, adequate management is perhaps the most valuable means to prevent environmental degradation of East Brimfield Lake without curtailing public use or access. The responsibility and authority of the Division of Forests and Parks are instrumental in assuring public safety at the Holland Pond and Streeter Point areas. Discontinuance of the present rules, regulations and overall supervision could lead to accelerated ecological and aesthetic damage caused by greater carelessness and negligence on the part of visitors to the project.

2. Single Purpose Management of Lands

At present, the Division of Forests and Parks manages parts of the East Brimfield project for day-use recreation. Active management for other uses is limited to pheasant stocking for hunters, trout stocking and, if successful, northern pike stocking for fishermen. The social and environmental benefits of these multiple uses vastly outweigh any benefits that could be achieved in simplicity of management or in economy. Indeed, economically, there are significant costs involved in correcting the damages done by narrow-sighted management, unless a project cannot conceivably be utilized for more than one purpose. Management for a single use, such as flood control, to the exclusion of others would unavoidably result in degradation to those aspects of the environment which are not consciously managed, but which are affected by operations. It is possible that single purpose management could be successful if all adverse environmental effects were taken into consideration and mitigated. However, mitigation of losses usually entails some specific management practices to protect fish and wildlife. And loss of recreation areas, while not subject to precise quantification, would inflict untold costs at a time when such areas are in great demand.

3. Multiple Use Management

The East Brimfield project is well managed for the two major purposes of flood control and recreation. However, broader multiple use management may be a beneficial alternative worthy of consideration. The Bureau of Sport Fisheries and Wildlife included several recommendations for reducing losses to wildlife in its pre-construction report for the project. The Bureau saw excellent opportunities for waterfowl management if pre-existing swampy areas were flooded to a shallow depth by either raising the elevation of the permanent pool or constructing dikes and low dams so that the water levels could be controlled. None of the recommendations were implemented. A potential still exists, therefore, for the creation of valuable waterfowl and duck nesting and breeding areas if the Massachusetts Division of Fisheries and Game or another agency wishes to undertake such a program. Open marshes of the type which could be formed at several locations within the project area are the highest-valued wetlands from a wildlife point of view. They also provide food and habitat for a variety of mammals and birds other than ducks.

Waterfowl management at East Brimfield could, with careful planning, be aesthetically oriented for greater general benefit by the public. If a shallow impoundment were created, a large number of ducks should be expected to nest in the area. Limited public access could then be provided for viewing the waterfowl at a distance without unnatural disturbance.

The Division of Fisheries and Game has largely concentrated its management, in other parts of Massachusetts, on the creation of pheasant cover and food sources to sustain a stocking program. These stocked pheasant are usually short-term residents, but the feed blocks also benefit other birds and wildlife. A moderate effort on the part of the Division of Fisheries and Game to improve habitats for non-game as well as other game species could realize increased aesthetic and hunting values at the East Brimfield project. Such enhanced resources would be beneficial to the environment for wildlife and for the purposes of recreation, the major responsibility and goal of the DNR's present lease of project lands.

No forest management is practiced within the reservoir, other than in relation to recreational development and for landscaping near the dam. In conjunction with wildlife management, selective thinning and clearing of wooded sections could have desirable environmental effects. Among these would be the stimulation of herbaceous growth close to the ground with noticeable benefits to habitat and food sources for animals and birds, as well as the improved health and accelerated growth of remaining stands of hard and softwoods. With environmental considerations foremost, scattered forest cutting is an excellent management tool. Economic justification for thinning is difficult unless the ultimate goal is commercial timber harvesting. The environmental benefits, however, would also be worthwhile. Moreover, any trees cut at East Brimfield would not be wasted, as there is ready use made of pole-sized trees and some lumber at game farms, hatcheries, wildlife management areas and parks across the State.

The existing and proposed picnic areas at East Brimfield Lake can themselves be managed more effectively for environmental and aesthetic values, particularly with regard to non-game wildlife species. Planting shade-tolerant shrubs and bushes in clumps throughout the picnicking sites would break up the repetitive visual aspect of stripped tree trunks and picnic tables. Such planting would also afford visitors more privacy, while providing them the enjoyment of small animals and birds. This varied habitat

is more conducive to utilization, especially by songbirds for nesting and feeding. Management for these non-game species has been neglected and now deserves appropriate consideration as part of an overall environmental management program at the project.

East Brimfield Lake presents an area favorably suited to several types of management for a number of environmental and non-conflicting recreational values. The alternatives for increasing forest, wildlife and waterfowl productivity are interrelated to the degree that emphasis cannot be placed on one alone. The Division of Fisheries and Game has a wealth of experience from management of other wildlife areas and recognizes the need for ecological assessment of any man-induced changes of the environment. The addition of new programs in the project area would more fully realize the social and environmental potential of the project without detracting from the important recreational use and flood control purposes which the area presently supports.

C. OTHER LAND MANAGEMENT ALTERNATIVES

The Corps of Engineers flood control projects in New England have been designed and built for the basic purpose of protecting the property and people living in the flood plain at the time of construction. However, such projects are not intended to prevent flooding of the entire flood plain under any situation, but only some frequency of flooding whose prevention can be justified economically. Development on flood prone areas has, in too many cases,

exceeded the capacity for protection conceived initially and has also reduced the river's natural flood storage. Thus, without farsighted planning on the part of downstream communities, an indirect adverse impact of flood control projects has often been the continued development of the flood plain. Such misguided construction, as in the case of a shopping center downstream of East Brimfield Dam, can sometimes jeopardize the efficiency of the dam's operation by placing constraints on the safe channel capacity of the river and necessitating further protection. There are a number of alternatives now advocated by the Corps for avoiding the flood damage/flood protection spiral. Most important for the Quinebaug River would be the elimination of encroachment on the flood plain by zoning or other restrictions. Alternatively, these areas might be acquired for the preservation of undeveloped river stretches as natural parts of the riverine ecosystem. The effectiveness of the flood protection now afforded by East Brimfield Dam can be continued only by coordinated Federal, State and local programs which stop the pre-emption of the flood plain for economic expansion. While the Corps of Engineers does not have the authority to impose regulations on flood plain and wetland use, it does encourage the enactment of such restrictions by the affected communities, and tries to impress upon them the limits of the flood protection. Provided, the enhanced hydraulic efficiency of an undeveloped river plain, as well as the benefits to be derived from preserved wetlands for recreation, fish and wildlife and aesthetics.

D. CONSTRUCTION AND MAINTENANCE ALTERNATIVES

1. Maintenance of Recreation Areas

The Corps of Engineers Master Plan for Reservoir Development, February 1968, for East Brimfield Reservoir has outlined future recreation possibilities for the Holland Pond, Conservation Pool, Long Pond and Lost Lake areas. The plan has attempted to be responsive to both the public demand for recreational opportunities and the need for preserving open space in lower density, less formal recreational areas.

At Holland Pond, for example, further development of the already heavily-used picnic and swimming site is limited to changing the access road, enlarging the beach, adding picnic tables and fireplaces and building another comfort station and parking lot. The facilities will relieve overcrowded conditions without committing an appreciably larger area to unnatural modification.

Across the pond the area north of Bridge Road and east of the Quinebaug River has been proposed for tent camping use. Foreseeable development includes only a comfort station, small beach and access roads. It is most difficult to recover the natural environmental character of any area which has been cleared of understory vegetation and trees and used intensively for picnicking or trailer camping. A wisely conservative policy has therefore been offered to avoid over-development of this site.

The Corps of Engineers has hoped to maintain Lost Lake in its natural setting except for constructing a small 30-car parking lot, comfort station and shelter. The presently unimproved area is even now a popular overnight and day-use area for youth groups from the Springfield Girls' and Boys' Camps.

Alternatives to proposed construction would involve either the extreme of doing nothing or determining the most feasible degree of development in light of beneficial and adverse impacts on the environment and recreation. The Corps' recreation plans have retained flexibility with respect to both the amount and the timing of construction at the East Brimfield project. It is desirable, however, that planned improvements at the Holland Pond and Streeter Road Day-Use Sites retain priority and that future building in natural areas be held to the minimum.

2. Aquatic Weed Control

The artificial conservation pool created by East Brimfield Dam was doomed to early eutrophication from its conception. The enriched bottomland which was flooded, the diffuse sources of nutrients from upstream agricultural runoff, and the shallowness of the lake have created a weed problem for which no effective long-term remedy exists. Mechanical cutting of aquatic weeds, biological and chemical control have all been used to combat the nuisance.

The chemical treatment as applied to practically the whole of East Brimfield project in 1972 has serious drawbacks ecologically. The weeds that are killed and the resulting nutrients in this plant matter sink to the bottom of the reservoir, where decomposition occurs with subsequent recycling of substances ideal for growth. Just as recent research and public concern has raised serious questions about the efficacy and safety of various agricultural pesticides, the nature of the environmental impacts of chemically treating aquatic weeds is not well understood.

As an alternative for controlling future weed problems which are sure to arise, it might be desirable to seriously consider treating only those areas of the conservation pool where aquatic vegetation poses the greatest nuisance, specifically at the boat launching ramps and swimming areas. Mechanical harvesting of weeds has proved to be a reasonable although usually more expensive, substitute for chemical control over small water areas. In the case of some water supply reservoirs where weeds have become abundant, this is the only alternative. If the weeds can be tolerated by recreation activities and users in a larger portion of the East Brimfield pool, and since prime growth is in the fewer shallow areas, mechanical removal may be worthy of investigation. This would also permit removal of the plant matter from the water rather than allowing it to decompose in situ.

F. SEASONAL WATER LEVEL MANAGEMENT

During design of East Brimfield Dam and Reservoir, the Corps of Engineers deliberated on the inclusion of a conservation pool at elevation 636.0 feet msl to afford less vertical fluctuation of the water level during release of low-flow augmentation storage for American Optical Company. The Bureau of Sport Fisheries and Wildlife also recommended a pool at this elevation as one way to achieve important waterfowl benefits through creation of extensive marshlands and shoal areas.

If the American Optical Company uses all of its presently allotted storage, the conservation pool drops 4 feet (elevation 632 to 628 feet msl) from the end of June until Labor Day and could remain at the lower level through December 31. One hundred (100) acres normally submerged is then exposed. If, however, the allotted storage of 1,190 acre-feet were provided at elevation 636 feet msl, the maximum pool drawdown would be approximately 1.7 feet in the same time period, but with exposure of 260 acres. It was decided however, that the loss of 2,200 acre-feet of potential storage, or about 7.5 percent of capacity above elevation 632.0 feet msl, would negate the benefits to fish and waterfowl from a permanent pool at 636.0 feet.

From April 1966 through mid-October 1967 the conservation pool was held experimentally at elevation 634, two feet above the normal pool surface. After inspection by New England Division Corps' personnel, state representatives and representatives of the U. S. Fish and Wildlife Service throughout the summer of 1966, it was decided that the pool should be maintained at a maximum elevation of 634 feet. This pool had a surface area of 470 acres, provided more suitable depths for swimming at the Streeter Road beach area, improved waterfowl habitat and allowed for less fluctuation of the water surface. Despite these benefits, the higher pool was not continued beyond the fall of 1967.

The alternative found to be valid in 1966 might again be considered since the benefits then enumerated remain applicable. The East Brimfield project area has been steadily increasing in number of visitors and overall recreation usage. The advantages of a higher, larger pool for swimming and boating have consequently increased in value, as would the benefits for fisheries and waterfowl, and the public's enjoyment of these resources. Moreover, this recommendation may be evaluated in view of the renewed northern pike stocking efforts by the Massachusetts Division of Fisheries and Game. The larger surface, greater depth and the more extensive shallow areas at the periphery might well have a beneficial influence on the success of pike in the reservoir.

In the same context, another alternative could be evaluated in terms of the effects on fishing quality and the northern pike stocking program. One important problem in warm water environments is the overcrowding of prey species (usually bluegills, pumpkinseeds, yellow perch and possibly shiners) due to a lack of predation. This may result in "stunted" populations, where fish 3 and 4 years old grow only an inch a year. One management approach used with varying degrees of success elsewhere is a winter drawdown of the water level. This crowds the predator (pickerel, largemouth bass and northern pike at East Brimfield) and prey into a smaller area where the predators take advantage of the increase in food abundance. When the technique has been successful, increased growth rates of both the predator and prey species (because of lessened competition) had been experienced. The Corps of Engineers and the Division of Fisheries and Game could cooperate in the seasonal drawdown on an experimental basis and determine also the desirability of a winter drawdown in conjunction with the higher summer pool discussed above.

VI. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S
ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM
PRODUCTIVITY

A. INTRODUCTION

Most flood control projects have been developed in response to an immediately perceived need, that of protecting valuable land uses from harmful flooding. Usually the response has occurred after some critically damaging flood, which made the need appear more urgent at the time. In these cases, hindsight tells us exactly where flood control is necessary and to what extent. What it does not tell us is that our vision may be obscured by that immediate need such that we only see the disastrous results of our problem but fail to see the potential effects of its solution. With respect to some of the projects that attempt to control nature, experience has shown us that such artificial manipulation, without sufficient long-term planning, can have serious adverse effects. Not only are future options foreclosed on use of the land, but alteration of the ecosystem may become so final and lasting that unforeseen influences result in secondary even more widespread impacts. Or, for example, flood control benefits derived initially may, in the future, no longer be necessary when such methods as strict land use regulation are instituted, the consequence being a tragic waste of resources.

The immediate benefits are flood prevention, and the effects are excellent on long-term economic development, as well as for maintenance of present levels of productivity. However, both positive and negative impacts must be weighed in not only quantitative, but also qualitative terms, so that our decisions will be justifiable in generations to come.

B. SOCIO-ECONOMIC EFFECTS

1. Flood Control Benefits

Communities along the entire length of the Quinebaug River experienced severe damages in the major flood of August, 1955. At that time, the Mansfield Hollow Dam on the Natchaug River at Mansfield Hollow, Connecticut was the only Corps of Engineers flood control project in operation. Within ten years of the flood, the other six projects in the Thames River basin comprehensive flood control system were constructed and operating.

Today the Quinebaug River valley supports a mixture of industrial and commercial enterprises with numerous factories, residences and other structures situated in the flood plain adjacent to the river. Some development has continued in the river lowlands - an unfortunate situation for a number of reasons. East Brimfield Dam and others on tributaries of the Thames River were designed to protect development already located in the flood plain. Guide curves for the regulation of East Brimfield, Westville and West Thompson Dams are provisional

due to the lack of observed and experienced flood data. Therefore, there is no ready guarantee that flood protection exists for certain areas along the river. Third, the inducement that flood control offers for development in the flood plain is not usually counterbalanced by regulations which govern use of this land, according to the river's hydraulic efficiency and ecological considerations, as well as the area's economic goals. Methods of long-term environmental planning are being developed to deal with the above problems, but in many cases clear channels for implementation and enforcement have yet to be defined. As a consequence, the sensitive and valuable flood plain ecosystem may incur damages which cannot be reversed or which become magnified in the long run, and which cannot be justified by the immediate or even short-term economic gains.

2. Recreational Benefits

East Brimfield Lake has met some of the great demand for water-related recreation and open space in south-central Massachusetts. The Holland Pond and Streeter Road sites provide organized facilities for swimming and picnicking, while much of the remainder of the project area is left in its natural state to be used for fishing, waterfowl hunting or nature study.

All of New England has rapidly become a center for both winter and summer recreational pursuits, as suggested by the substantial increase in leisure home development. In the rural East Brimfield area, the proximity of the project to Old Sturbridge Village, a unique historical site, has made the reservoir's formal recreation facilities even more popular and accessible. The City of Springfield Boys' and Girls' Clubs have long utilized the project's resources for overnight camping and boating. Their continued enjoyment of the area is but one of the project's contributions to the healthful development of youth from a depressed urban area. As government-owned, public land, the dam and reservoir site also preserves natural forested areas, and extensive wetlands for both the enhanced enjoyment of the general public and the protection of fish and wildlife habitat, particularly for migrating waterfowl. The waterfowl habitat could also be expanded and improved in the future to provide a better, permanent environment for nesting.

Nevertheless, today, recreation demands fall into two extreme categories: that for additional formal development, such as trailer sites and picnic areas, and the other for natural open space with a minimum of artificial changes. Therefore, in planning for the long-term productivity and enjoyment of the reservoir environment, both the use limit of an area must be considered and the desire to protect an adequate reserve of untouched land for future generations and future options.

C. BIOLOGICAL COMMUNITIES AND ECOSYSTEMS

1. Changes in Land Use

Despite the hazard of flooding, the lowlands of the Quinebaug River have in the past been most valuable sites for development. Even prior to the 1955 flood, the riverway had to a degree been sacrificed in favor of economic efficiency, but the East Brimfield and other dams in the comprehensive flood control network have provided the reassurance and possibly the justification for further encroachment on the flood plain. The effects on biological communities cannot, in the long term, be evaluated simply as losses of vegetation and habitat suitable for fish and wildlife. The precedent for economic use of the flood plain is not easily changed, especially in view of the capital investments for flood control.

Inundation of the flood plain is both natural and extremely valuable from an ecological perspective. When buildings preempt the riverway, however, the destruction of the flood plain results in direct, permanent loss of fish and wildlife, less diversity of species, and less diversity of land uses. It is essentially impossible to reclaim that flood plain or the environment and wildlife that have disappeared. It is evident,

therefore, that long range environmental protection cannot always be achieved by structural measures, such as flood control reservoirs, if their presence creates problems for another part of man's environment. Specific structural measures must be supplemented by comprehensive land use planning with delineation, zoning, regulation and/or acquisition of flood plain areas.

2. Modification of Stream Flows

The artificial manipulation of flows may have only short-term effects on the aquatic biota in a particular stream or tributary, such as the upper Quinebaug River. The ecosystem is sensitive to change, however, and plants and animals may adapt to environmental modifications in ways which are in fact undesirable. The spawning of warm and cold water fish can be upset by drastic changes in streamflow and populations may become unbalanced as a result. While East Brimfield Dam does not itself alter flows substantially, mainly because of the reservoir's large size, it will contribute to the streamflow changes caused by a comprehensive network of flood control structures. In addition, when downstream flood plain inundation is reduced, alteration of food chain relationships occurs, causing still other long-term adverse biotic responses.

VII. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES
WHICH ARE INVOLVED IN THE OPERATION AND MAINTENANCE PROGRAM

A. LOSS OF NATURAL RESOURCES DUE TO PERIODIC FLOODING

The operation of East Brimfield Dam requires flooding of varying areas of the reservoir whenever runoff is sufficient or potentially great enough to endanger lives and property in the downstream flood hazard zones. This procedure has committed 400 acres of swamp, brush and forest land to inundation about once a year. Some losses of trees, shrubs and other vegetation will therefore be experienced around the perimeter of the conservation pool, and at higher elevations in the event of a very large flood.

Both game and non-game species of wildlife suffer the effects of flooding within the reservoir. Besides the temporary loss of habitat as flood waters are impounded, some drowning of animals and their young has and will occur. Without the mitigating influence of wildlife management practices, some of the lowest vegetation may be altered by flooding and become less favorable for upland game wildlife with a consequent decrease in populations or displacement to other areas better suited for survival and reproduction.

B. CONSTRUCTION OR REMOVAL OF RESOURCES BY OTHERS UNDER
EASEMENT OR LICENSE PROGRAM

Public access to the west shore of Long Pond has been hampered by private construction activities and general encroachment on flowage easement lands by landowners adjacent to the reservoir. This problem may be due to the

Corps' failure to purchase land outside of the five year flood frequency line, and now, adjacent landowners want to take advantage of their access to the river and reservoir.

Their immediate proximity to Long Pond, and also areas of Lost Lake, has encouraged the feeling that encroachment is inconsequential. However, such a situation limits the expansion possibilities of recreation areas and discourages visitors from using those lands that are public. Whether intentional or not, obstruction of public use represents a significant loss of recreational opportunities.

VIII. COORDINATION WITH OTHER AGENCIES

Coordination with various Federal, State and Local interests resulted in valuable input to this assessment. Both meetings and correspondence proved to be very helpful. Following is a list of the several interests with whom coordination took place:

Bureau of Sport Fisheries and Wildlife

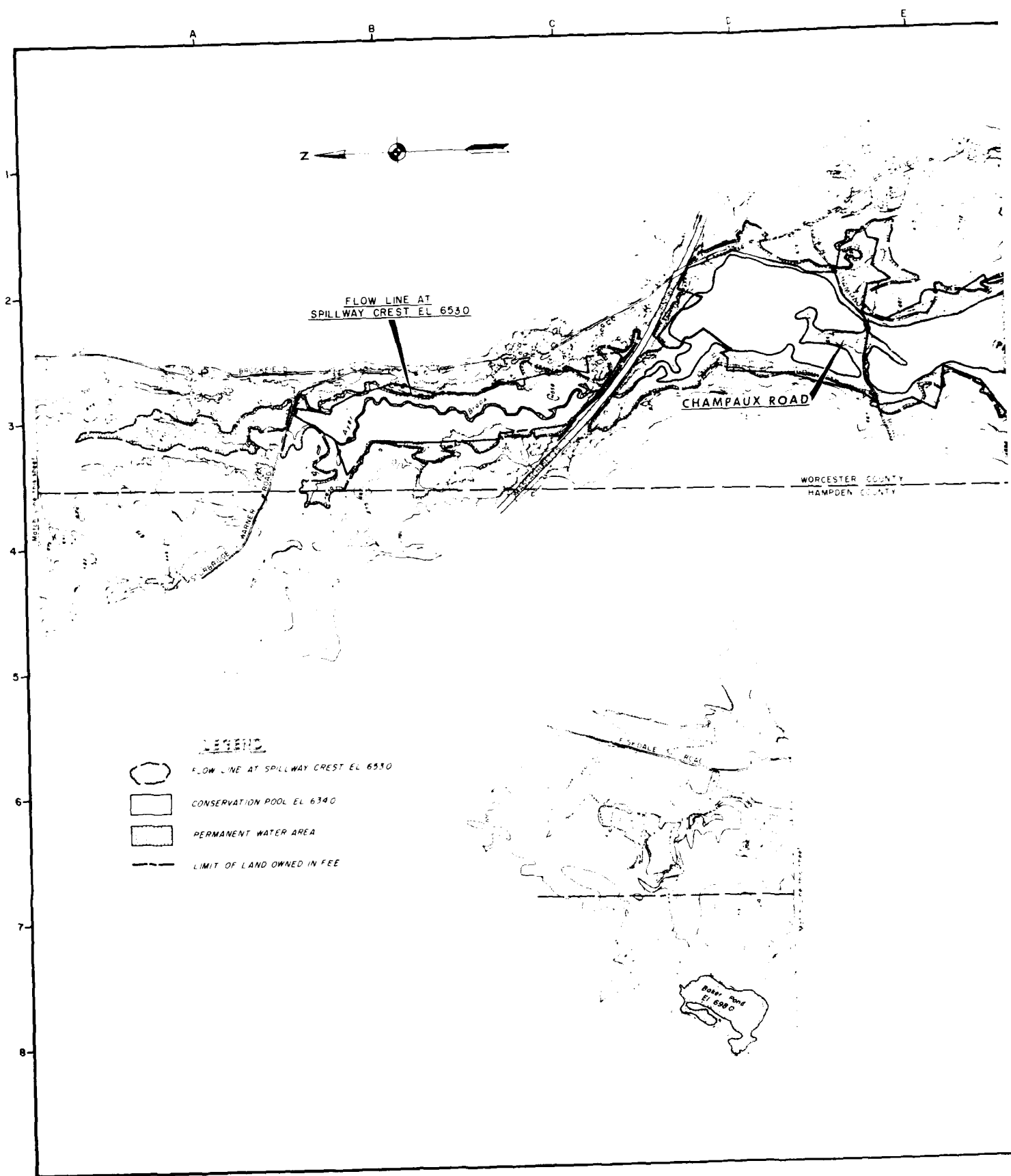
Soil Conservation Service

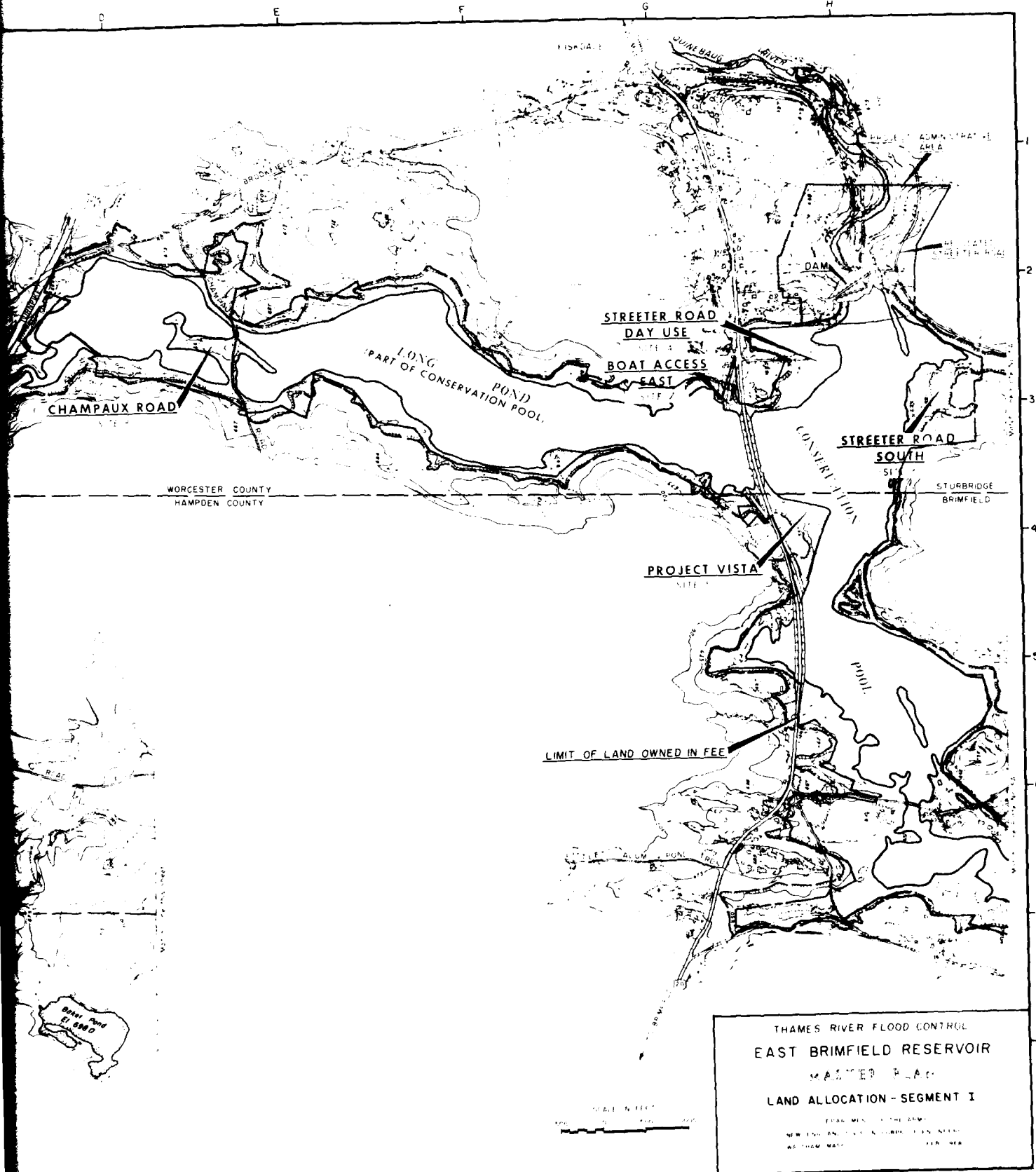
New England River Basins Commission

Massachusetts Division of Forests and Parks

Massachusetts Division of Fisheries and Game

Massachusetts Audubon Society





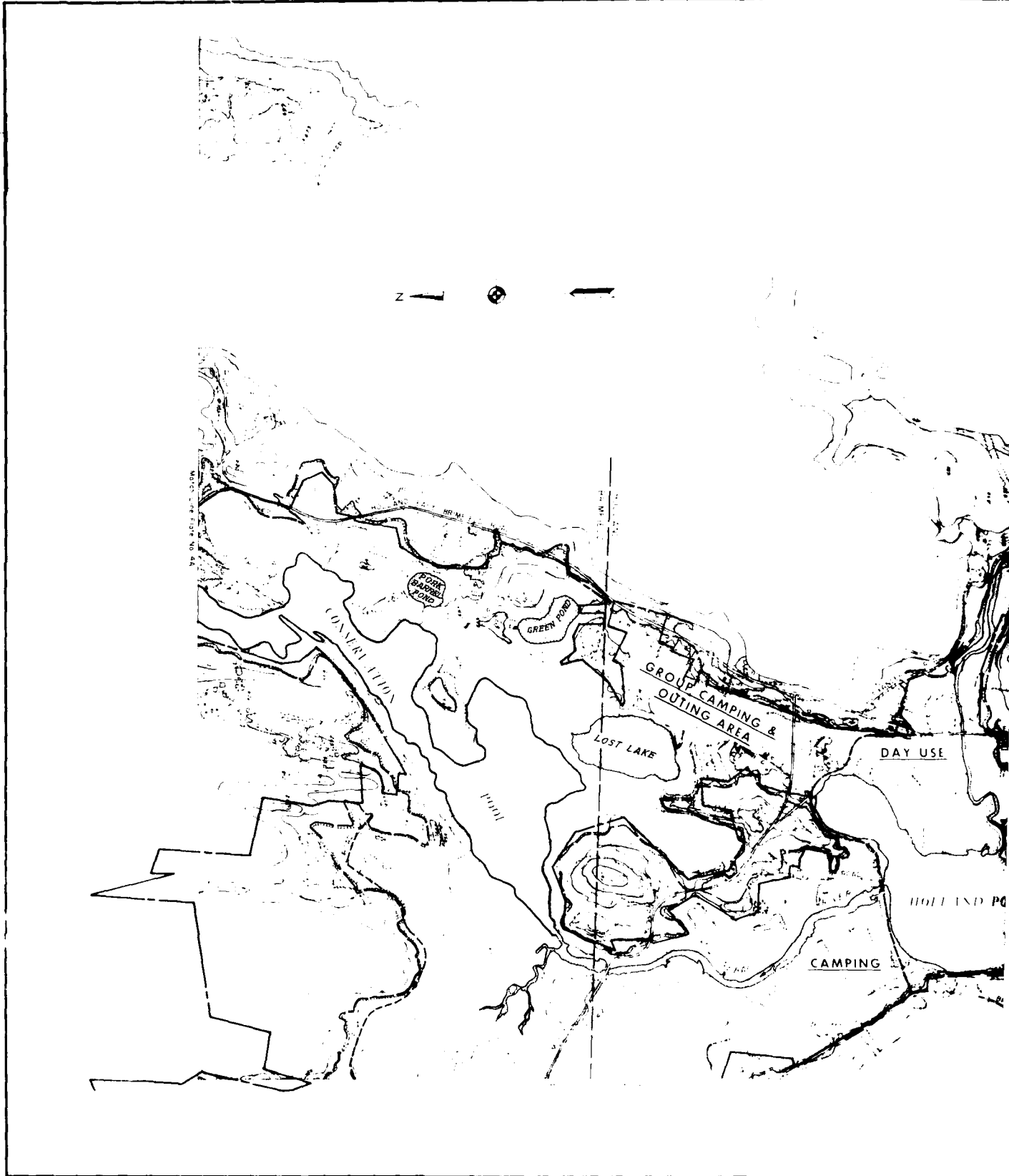
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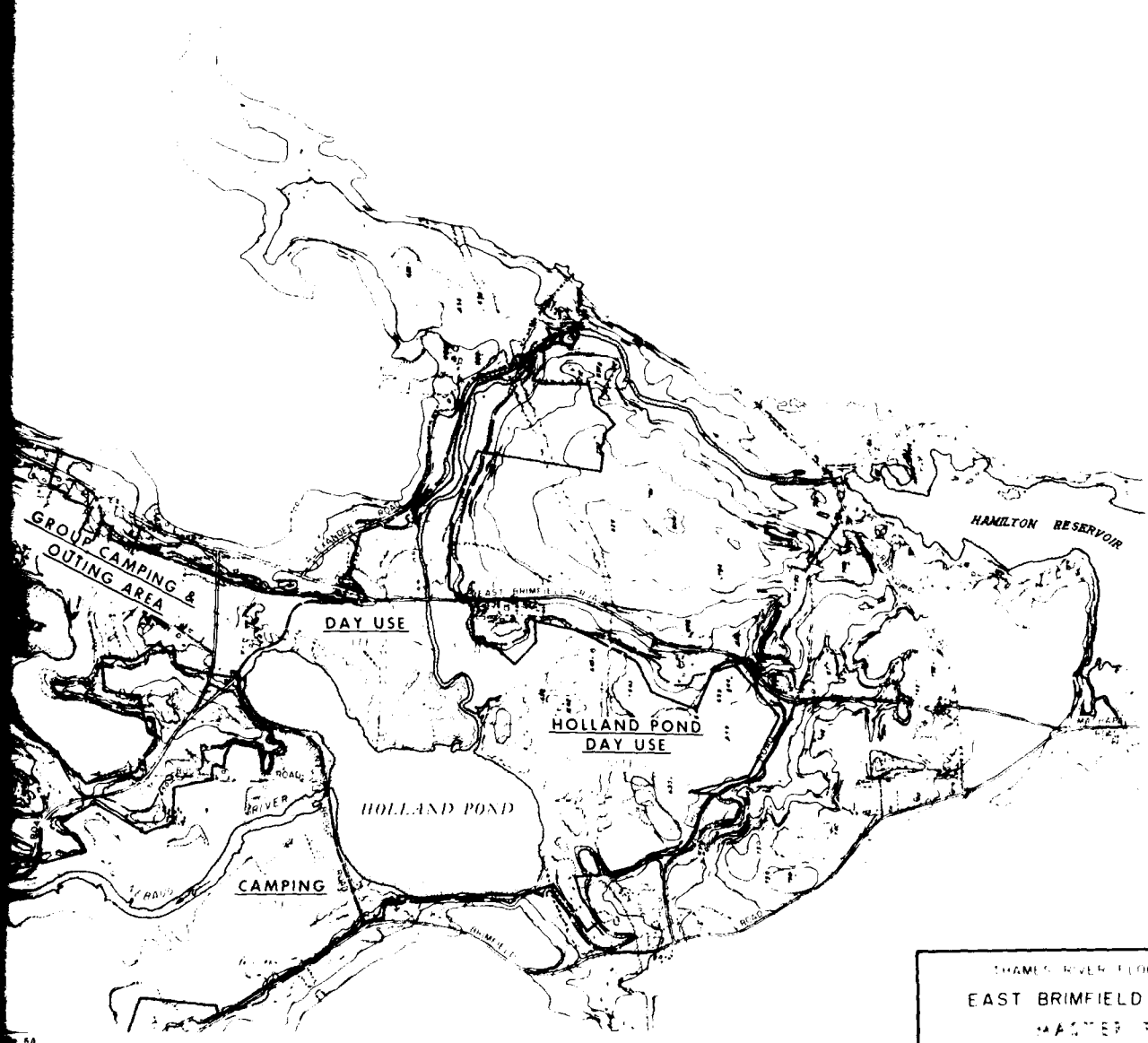
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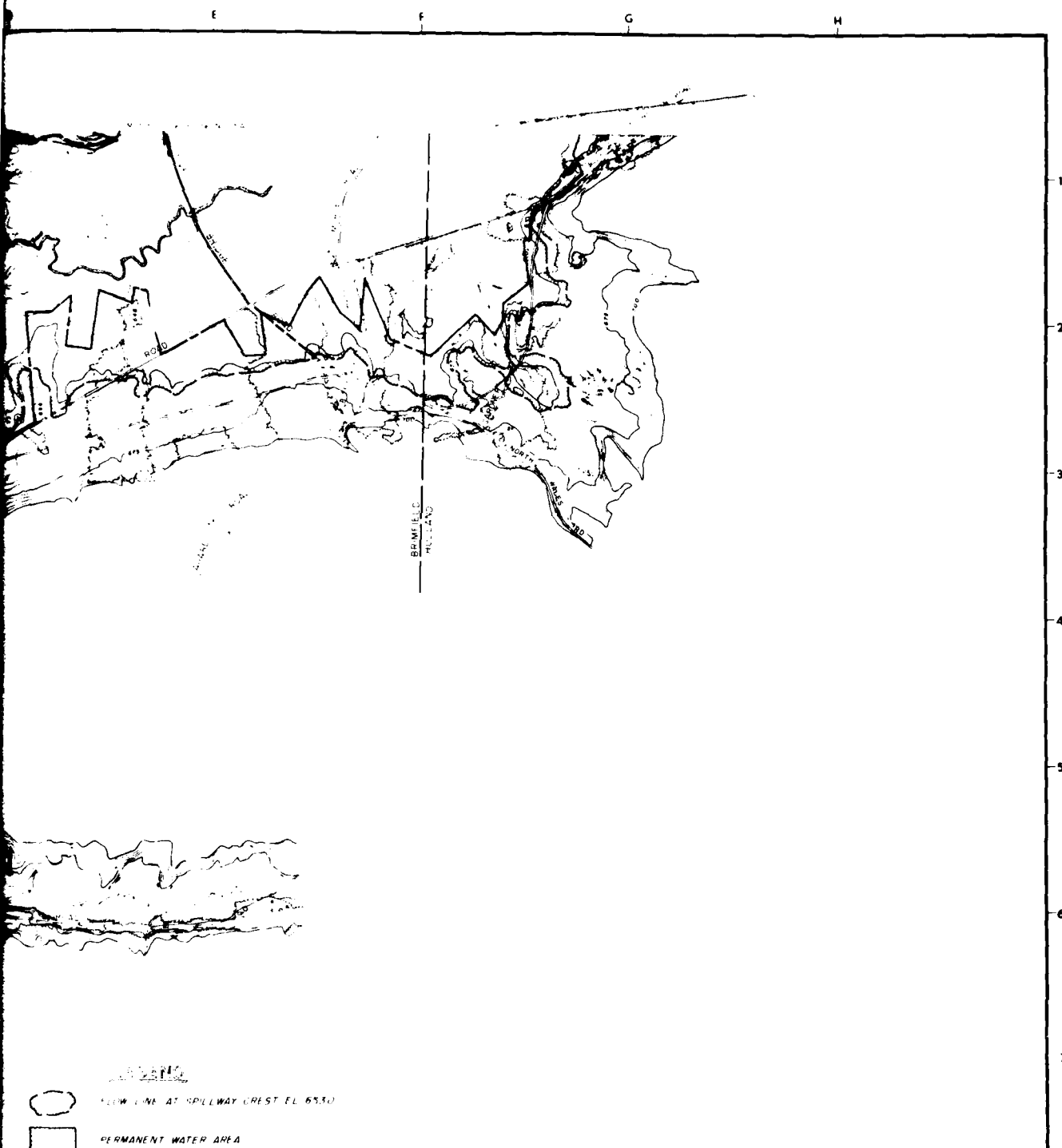
- LEGEND
- LOWEST ELEVATION (100 FEET OR LESS)
 - WATER BODIES
 - WATERWAYS
 - WATERWAYS






THAMES RIVER FLOOD CONTROL
EAST BRIMFIELD RESERVOIR
MASTER PLAN
LAND ALLOCATION - SEGMENT II

U.S. ARMY
ENGINEER
CORPS





-  FLOW LINE AT SPILLWAY CREST EL. 65.30
-  PERMANENT WATER AREA
-  LIMIT OF LAND OWNED IN FEE

THAMES RIVER FLOOD CONTROL
 EAST BRIMFIELD RESERVOIR
 MASTER PLAN
 LAND ALLOCATION - SEGMENT III

U.S. ARMY
 CORPS OF ENGINEERS
 WASHINGTON, D.C.

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